

# SEQUENCE LISTING

<110> Hallahan, David L.

<120> cis-Prenyltransferases from Plants

<130> BC1019 US NA

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<151> 1999-09-21

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<212> DNA

<213> Dimorphotheca

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<212> PRT

<213> Dimorphotheca

<400> 2

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      20              25              30

Ser Asp Thr Thr Gly Gly Gly Ile Asn Ser Leu Glu Glu Arg Ile Thr
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Pro Ala Gly Leu Lys His Glu Leu Met Pro Lys His Val Ala Val Ile  
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 Met Asp Gly Asn Arg Arg Trp Ala Arg Ser Arg Gly Leu Met Pro Asp  
 65 70 75 80  
 Ala Gly Tyr Met Glu Gly Ala Arg Ser Leu Lys Val Met Val Glu Leu  
 85 90 95  
 Cys Arg Lys Trp Gly Ile Gln Val Leu Thr Val Phe Ala Phe Ser Ala  
 100 105 110  
 Asp Asn Trp Leu Arg Pro Lys Val Glu Val Asp Phe Leu Met Gly Leu  
 115 120 125  
 Ile Glu Ser Val Leu Lys Asp Glu Val Val His Met Ile Lys Glu Gly  
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 Lys Arg Ile Ile Thr Tyr Ala Glu Asn Ile Thr Lys Asn Asn Ser Gln  
 165 170 175  
 Leu Asn Leu Val Val Ala Ile Asn Tyr Ser Gly Lys Tyr Asp Ile Val  
 180 185 190  
 Gln Ala Cys Gln Ser Ile Ala Leu Lys Val Lys Asp Gly Val Ile Gln  
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 Pro Glu Glu Ile Asn Glu Phe Thr Ile Glu Asn Glu Leu Gly Thr Asn  
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 Cys Ile Pro Phe Pro His Pro Asp Leu Leu Ile Arg Thr Ser Gly Glu  
 225 230 235 240  
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 245 250 255  
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 <212> DNA  
 <213> Calendula officinalis

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 tacagtggaa aatacgacat aatcgaagct tgtaaaagcg tcgctacaaa agtcaaggat 660

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<210> 4  
 <211> 228  
 <212> PRT  
 <213> Calendula officinalis

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          20          25          30

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          35          40          45

Val Ser Ile Tyr Ala Phe Ser Thr Glu Asn Trp Thr Arg Pro Lys Glu
          50          55          60

Glu Val Asp Phe Leu Met Glu Met Tyr Glu Asp Leu Leu Arg Thr Asp
          65          70          75          80

Ala Glu Glu Leu Leu Ser Leu Gly Cys Arg Val Ser Ile Met Gly Lys
          85          90          95

Lys Thr Asn Leu Pro Lys Ser Leu Gln Lys Leu Cys Ile Glu Ile Glu
          100          105          110

Glu Lys Ser Arg Ala Asn Ser Gly Thr His Val Asn Tyr Ala Leu Asn
          115          120          125

Tyr Ser Gly Lys Tyr Asp Ile Ile Glu Ala Cys Lys Ser Val Ala Thr
          130          135          140

Lys Val Lys Asp Gly Val Ile Ile Pro Lys Gln Ile Asp Glu Lys Tyr
          145          150          155          160

Phe Lys Gln Glu Leu Gly Thr Lys Met Ile Asp Phe Pro Tyr Pro Asp
          165          170          175

Leu Val Ile Arg Thr Ser Gly Glu Ile Arg Leu Ser Asn Phe Met Leu
          180          185          190

Trp Gln Met Ala Tyr Ser Glu Leu Tyr Phe Thr Asp Lys Tyr Phe Pro
          195          200          205

Asp Phe Gly Glu Asn Asp Leu Ile Glu Ala Leu Leu Ala Phe Gln Lys
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Val Arg Lys Cys
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 <211> 1071

<212> DNA  
<213> Hevea brasiliensis

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taagtcagtg atttaaggaa aatggaatta tacaacggtg agaggccaag tgtgttcaga 180  
cttttaggga agtatatgag aaaaggggta tatagcatcc taaccagggt tcccatccct 240  
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gaaggagggtg gtcataaggc tggattttta gctcttctga acgtactaac ttattgctat 360  
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gaagaaagta tcatcaatgc atatgatatt tgcgtacgtt ttgtgggtaa cctgaagcct 540  
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<210> 6  
<211> 290  
<212> PRT  
<213> Hevea brasiliensis

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Pro Thr His Ile Ala Phe Ile Leu Asp Gly Asn Arg Arg Phe Ala Lys  
35 40 45  
Lys His Lys Leu Pro Glu Gly Gly Gly His Lys Ala Gly Phe Leu Ala  
50 55 60  
Leu Leu Asn Val Leu Thr Tyr Cys Tyr Glu Leu Gly Val Lys Tyr Ala  
65 70 75 80  
Thr Ile Tyr Ala Phe Ser Ile Asp Asn Phe Arg Arg Lys Pro His Glu  
85 90 95  
Val Gln Tyr Val Met Asp Leu Met Leu Glu Lys Ile Glu Gly Met Ile  
100 105 110  
Met Glu Glu Ser Ile Ile Asn Ala Tyr Asp Ile Cys Val Arg Phe Val  
115 120 125  
Gly Asn Leu Lys Leu Leu Ser Glu Pro Val Lys Thr Ala Ala Asp Lys  
130 135 140  
Ile Met Arg Ala Thr Ala Asn Asn Ser Lys Cys Val Leu Leu Ile Ala  
145 150 155 160  
Val Cys Tyr Thr Ser Thr Asp Glu Ile Val His Ala Val Glu Glu Ser  
165 170 175  
Ser Glu Leu Asn Ser Asn Glu Val Cys Asn Asn Gln Glu Leu Glu Glu  
180 185 190

Ala Asn Ala Thr Gly Ser Ser Thr Val Ile Gln Thr Glu Asn Met Glu  
195 200 205

Ser Tyr Ser Gly Ile Lys Leu Val Asp Leu Glu Lys Asn Thr Tyr Ile  
210 215 220

Asn Pro Tyr Pro Asp Val Leu Ile Arg Thr Ser Gly Glu Thr Arg Leu  
225 230 235 240

Ser Asn Tyr Leu Leu Trp Gln Thr Thr Asn Cys Ile Leu Tyr Ser Pro  
245 250 255

Tyr Ala Leu Trp Pro Glu Ile Gly Leu Arg His Val Val Trp Ser Val  
260 265 270

Ile Asn Phe Gln Arg His Tyr Ser Tyr Leu Glu Lys His Lys Glu Tyr  
275 280 285

Leu Lys  
290

<210> 7  
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<212> DNA  
<213> Hevea brasiliensis

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<210> 8  
<211> 290  
<212> PRT  
<213> Hevea brasiliensis

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Lys Tyr Met Arg Lys Gly Leu Tyr Ser Ile Leu Thr Gln Gly Pro Ile  
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Pro Thr His Ile Ala Phe Ile Leu Asp Gly Asn Arg Arg Phe Ala Lys  
35 40 45

Lys His Lys Leu Pro Glu Gly Gly Gly His Lys Ala Gly Phe Leu Ala  
50 55 60

Leu Leu Asn Val Leu Thr Tyr Cys Tyr Glu Leu Gly Val Lys Tyr Ala  
 65 70 75 80  
 Thr Ile Tyr Ala Phe Ser Ile Asp Asn Phe Arg Arg Lys Pro His Glu  
 85 90 95  
 Val Gln Tyr Val Met Asp Leu Met Leu Glu Lys Ile Glu Gly Met Ile  
 100 105 110  
 Met Glu Glu Ser Ile Ile Asn Ala Tyr Asp Ile Cys Val Arg Phe Val  
 115 120 125  
 Gly Asn Leu Lys Leu Leu Ser Glu Pro Val Lys Thr Ala Ala Asp Lys  
 130 135 140  
 Ile Met Arg Ala Thr Ala Asn Asn Ser Lys Cys Val Leu Leu Ile Ala  
 145 150 155 160  
 Val Cys Tyr Thr Ser Thr Asp Glu Ile Val His Ala Val Glu Glu Ser  
 165 170 175  
 Ser Glu Leu Asn Ser Asn Glu Val Cys Asn Asn Gln Glu Leu Glu Glu  
 180 185 190  
 Ala Asn Ala Thr Gly Ser Ser Thr Val Ile Gln Thr Glu Asn Met Glu  
 195 200 205  
 Ser Tyr Ser Gly Ile Lys Leu Val Asp Leu Glu Lys Asn Thr Tyr Ile  
 210 215 220  
 Asn Pro Tyr Pro Asp Val Leu Ile Arg Thr Ser Gly Glu Thr Arg Leu  
 225 230 235 240  
 Ser Asn Tyr Leu Leu Trp Gln Thr Thr Asn Cys Ile Leu Tyr Ser Pro  
 245 250 255  
 Tyr Ala Leu Trp Pro Glu Ile Gly Leu Arg His Val Val Trp Ser Val  
 260 265 270  
 Ile Asn Phe Gln Arg His Tyr Ser Tyr Leu Glu Lys His Lys Glu Tyr  
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 Leu Lys  
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<210> 9  
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 <213> Hevea brasiliensis

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<210> 10
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<212> PRT
<213> Hevea brasiliensis

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Pro Thr His Leu Ala Phe Ile Met Asp Gly Asn Arg Arg Phe Ala Lys
          35          40          45

Lys His Lys Met Lys Glu Ala Glu Gly Tyr Lys Ala Gly Tyr Leu Ala
          50          55          60

Leu Leu Arg Thr Leu Thr Tyr Cys Tyr Glu Leu Gly Val Arg Tyr Val
          65          70          75          80

Thr Ile Tyr Ala Phe Ser Ile Asp Asn Phe Arg Arg Gln Pro Arg Glu
          85          90          95

Val Gln Cys Val Met Asn Leu Met Met Glu Lys Ile Glu Glu Ile Ile
          100          105          110

Val Glu Glu Ser Ile Met Asn Ala Tyr Asp Val Gly Val Arg Ile Val
          115          120          125

Gly Asn Leu Asn Leu Leu Asp Glu Pro Ile Arg Ile Ala Ala Glu Lys
          130          135          140

Ile Met Arg Ala Thr Ala Asn Asn Ser Gly Phe Val Leu Leu Ile Ala
          145          150          155          160

Val Ala Tyr Ser Ser Thr Asp Glu Ile Gly His Ala Val Glu Glu Ser
          165          170          175

Ser Lys Asp Lys Leu Asn Ser Asn Glu Val Cys Asn Asn Gly Ile Glu
          180          185          190

Ala Glu Gln Glu Phe Lys Glu Ala Asn Gly Thr Gly Asn Ser Val Ile
          195          200          205

Pro Val Gln Lys Thr Glu Ser Tyr Ser Gly Ile Asn Leu Ala Asp Leu
          210          215          220

Glu Lys Asn Thr Tyr Val Asn Pro His Pro Asp Val Leu Ile Arg Thr
          225          230          235          240

Ser Gly Leu Ser Arg Leu Ser Asn Tyr Leu Leu Trp Gln Thr Ser Asn
          245          250          255

Cys Ile Leu Tyr Ser Pro Phe Ala Leu Trp Pro Glu Ile Gly Leu Arg
          260          265          270

His Leu Val Trp Thr Val Met Asn Phe Gln Arg His His Ser Tyr Leu
          275          280          285

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Glu Lys His Lys Glu Tyr Leu Lys  
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<211> 1232  
<212> DNA  
<213> Vitis sp

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<211> 309  
<212> PRT  
<213> Vitis sp

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Phe Lys Ser Lys His Ser Ser Cys Thr Phe Arg Ser Asn Arg Ile Asp  
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Ser Phe Ser Phe Pro Pro Ile Ser Val Pro Arg Phe His Lys Leu Arg  
35 40 45  
Thr Ala Lys Thr Asp Val Val Gly Glu Glu Glu Ala Arg Glu Val Asn  
50 55 60  
Glu Arg Ala Glu Glu Phe Pro Asp Gly Leu Arg Arg Glu Leu Met Pro  
65 70 75 80  
Glu His Val Ala Val Ile Met Asp Gly Asn Val Arg Trp Ala Gln Lys  
85 90 95  
Arg Gly Leu Pro Ala Ala Ser Gly His Gln Ala Gly Val Arg Ser Leu  
100 105 110  
Arg Glu Leu Val Glu Leu Cys Cys Lys Trp Gly Ile Lys Val Leu Ser  
115 120 125



Val	Phe	Ala	Phe	Ser	Tyr	Asp	Asn	Trp	Ser	Arg	Ser	Glu	Gly	Glu	Val
130						135					140				
Gly	Phe	Leu	Met	Ser	Leu	Ile	Glu	Arg	Val	Val	Lys	Ala	Glu	Leu	Pro
145					150					155					160
Ile	Leu	Gly	Gly	Lys	Ala	Phe	Glu	Cys	Arg	Asp	Trp	Gly	Phe	Val	Lys
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			180					185					190		
Glu	Asn	Ser	Arg	Leu	Gln	Phe	Ile	Val	Ala	Leu	Ser	Tyr	Ser	Gly	Gln
		195					200					205			
Cys	Asp	Ile	Leu	Gln	Ala	Cys	Lys	Asn	Ile	Gly	His	Lys	Val	Lys	Asp
	210					215					220				
Gly	Leu	Ile	Glu	Pro	Glu	Asp	Ile	Asn	Lys	Ser	Leu	Ile	Glu	Gln	Glu
225					230					235					240
Leu	Gln	Thr	Asn	Cys	Thr	Glu	Phe	Pro	Phe	Pro	Asp	Leu	Leu	Ile	Arg
				245					250					255	
Thr	Ser	Gly	Glu	Leu	Arg	Val	Ser	Asn	Phe	Met	Leu	Trp	Gln	Ile	Ala
			260					265					270		
Tyr	Thr	Glu	Leu	Cys	Phe	Phe	Ser	Thr	Leu	Trp	Pro	Asp	Phe	Gly	Lys
		275					280					285			
Asp	Glu	Phe	Val	Glu	Ala	Leu	Ser	Ser	Phe	Gln	Lys	Arg	Gln	Arg	Arg
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305															

<210> 13  
 <211> 1021  
 <212> DNA  
 <213> Oryza sativa

<400> 13  
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 <213> Oryza sativa

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                   20                  25                  30  
 Ala Leu Ile Ala Ser Leu Leu Tyr Cys Tyr Glu Met Gly Val Lys Tyr  
                   35                  40                  45  
 Ile Thr Val Tyr Ala Phe Ser Ile Asp Asn Phe Lys Arg Asp Pro Thr  
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 Glu Val Lys Ser Leu Met Glu Leu Met Glu Glu Lys Ile Asn Glu Leu  
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 Lys Leu Met Ala Thr Thr Ala Glu Asn Thr Gly Leu Val Phe Ser Val  
           115                  120                  125  
 Cys Met Pro Tyr Asn Ser Thr Ser Glu Ile Val Asn Ala Val Asn Lys  
           130                  135                  140  
 Val Cys Ala Glu Arg Arg Asp Ile Leu Gln Arg Glu Asp Ala Asp Ser  
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 Val Ala Asn Asn Gly Val Tyr Ser Asp Ile Ser Val Ala Asp Leu Asp  
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           180                  185                  190  
 Thr Ser Gly Glu Thr Arg Leu Ser Asn Phe Leu Leu Trp Gln Thr Thr  
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 Phe Ser His Leu Gln Asn Pro Asp Pro Leu Trp Pro Glu Phe Ser Phe  
           210                  215                  220  
 Lys His Leu Val Trp Ala Ile Leu Gln Tyr Gln Arg Val His Pro Ser  
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 <213> *Oryza sativa*

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Asn Phe Ile Arg Lys Cys Ile Val Ala Val Leu Ser Tyr Gly Pro Met
          35              40              45

Pro Lys His Ile Ala Phe Ile Met Asp Gly Asn Arg Arg Tyr Ala Lys
          50              55              60

Phe Arg Ser Ile Gln Glu Gly Ser Gly His Arg Val Gly Phe Ser Ala
          65              70              75              80

Leu Ile Ala Ser Leu Leu Tyr Cys Tyr Glu Met Gly Val Lys Tyr Ile
          85              90              95

Thr Val Tyr Ala Phe Ser Ile Asp Asn Phe Lys Arg Asp Pro Thr Glu
          100             105             110

Val Lys Ser Leu Met Glu Leu Met Glu Glu Lys Ile Asn Glu Leu Leu
          115             120             125

Glu Asn Arg Asn Val Ile Asn Lys Val Asn Cys Lys Ile Asn Phe Trp
          130             135             140

Gly Asn Leu Asp Met Leu Ser Lys Ser Val Arg Val Ala Ala Glu Lys
          145             150             155             160

Leu Met Ala Thr Thr Ala Glu Asn Thr Gly Leu Val Phe Ser Val Cys
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Met Pro Tyr Asn Ser Thr Ser Glu Ile Val Asn Ala Val Asn Lys Val
          180             185             190

Cys Ala Glu Arg Arg Asp Ile Leu Gln Arg Glu Asp Ala Asp Ser Val
          195             200             205

Ala Asn Asn Gly Val Tyr Ser Asp Ile Ser Val Ala Asp Leu Asp Arg
          210             215             220

His Met Tyr Ser Ala Gly Cys Pro Asp Pro Asp Ile Val Ile Arg Thr
          225             230             235             240

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Ser Gly Glu Thr Arg Leu Ser Asn Phe Leu Leu Trp Gln Thr Thr Phe  
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Ser His Leu Gln Asn Pro Asp Pro Leu Trp Pro Glu Phe Ser Phe Lys  
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His Leu Val Trp Ala Ile Leu Gln Tyr Gln Arg Val His Pro Ser Ile  
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Cys Tyr His Pro Phe His His Arg Ser Gln Thr Gln Ser Leu Ile Val  
35 40 45

Ser Lys Arg Gly Ser Ala Ile Ala Lys Cys His Ala Asp Ser Val Thr  
50 55 60

Leu Arg Asp Asp Gly Val Ser Leu Ala Gln Glu Ser Leu Glu Pro Leu  
65 70 75 80

Pro Ala Glu Leu Ala Ala Glu Met Met Pro Lys His Val Ala Val Ile  
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			165						170					175		
Ile	Arg	Ile	Ser	Val	Ile	Gly	Asp	Ser	Ser	Arg	Leu	Pro	Glu	Ser	Leu	
			180					185					190			
Lys	Arg	Met	Ile	Ala	Ser	Ala	Glu	Glu	Asp	Thr	Lys	Gln	Asn	Ser	Arg	
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Phe	Gln	Leu	Ile	Val	Ala	Val	Gly	Tyr	Ser	Gly	Lys	Tyr	Asp	Val	Val	
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Gln	Ala	Cys	Lys	Ser	Val	Ala	Lys	Lys	Val	Lys	Asp	Gly	His	Ile	His	
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Leu	Asp	Asp	Ile	Asn	Glu	Asn	Ile	Ile	Glu	Gln	Glu	Leu	Glu	Thr	Asn	
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Cys	Thr	Glu	Phe	Pro	Tyr	Pro	Asp	Leu	Leu	Ile	Arg	Thr	Ser	Gly	Glu	
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		275					280					285				
Tyr	Phe	Asn	Arg	Glu	Leu	Trp	Pro	Asp	Phe	Gly	Lys	Asp	Glu	Phe	Val	
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<211> 1026

<212> DNA

<213> Triticum aestivum

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 35 40 45  
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 65 70 75 80  
 Ala Phe Gly Phe Ser Leu Glu Asn Trp Asn Arg Pro Lys Ala Glu Val  
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 Asp Phe Leu Met Ala Leu Ile Glu Arg Phe Ile Asn Asp Asn Leu Ala  
 100 105 110  
 Glu Phe Leu Arg Glu Gly Thr Arg Leu Arg Ile Ile Gly Asp Arg Ser  
 115 120 125  
 Arg Leu Pro Ile Ser Val Gln Lys Thr Ala Arg Asp Ala Glu Glu Ala  
 130 135 140  
 Thr Arg Asn Asn Ser Gln Leu Asp Leu Val Leu Ala Ile Ser Tyr Ser  
 145 150 155 160  
 Gly Arg Met Asp Ile Val Gln Ala Cys Arg Asn Leu Ala Gln Lys Val  
 165 170 175  
 Asp Ala Lys Leu Leu Arg Pro Glu Asp Ile Asp Glu Ser Leu Phe Ala  
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 Asp Glu Leu Gln Thr Ser Glu Thr Ser Cys Pro Asp Leu Leu Ile Arg  
 195 200 205  
 Thr Ser Gly Glu Leu Arg Leu Ser Asn Phe Leu Leu Trp Gln Ser Ala  
 210 215 220  
 Tyr Ser Glu Leu Phe Phe Thr Asp Thr Leu Trp Pro Asp Phe Gly Glu  
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 <301> Apfel, C. M.  
 <302> Use of Genomincs to Indentify Bacterial Undecaprenyl  
           Pyrophosphate Synthetase: Clooning, Expression, and  
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 <303> J. Bacteriol.  
 <304> 81  
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 <303> J. Biol. Chem.  
 <304> 273  
 <306> 19476-19481  
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Pro Lys Asp Glu Val Asn Tyr Leu Met Lys Leu Pro Gly Asp Phe Leu  
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 35 40 45  
 Lys Glu Met Asp Val Lys Glu Gly His Glu Ala Gly Phe Val Ser Met  
 50 55 60  
 Ser Arg Ile Leu Glu Leu Cys Tyr Glu Ala Gly Val Asp Thr Ala Thr  
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 Val Gln His Lys Lys Gly Ala Ala Ile Asp Glu Ser Thr Leu Glu Ser  
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Pro Val Pro Glu His Val Ser Phe Ile Met Asp Gly Asn Arg Arg Tyr
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Ala Lys Ser Arg Arg Leu Pro Val Lys Lys Gly His Glu Ala Gly Gly
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Lys Ile Lys Lys Val Glu Glu Ile Thr Gln Asp Gly Asp Asp Phe Thr
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